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ABSTRACT

Video presentations of teaching episodes in home, school, and community settings and audio recordings of parents' and professionals' views can be important adjuncts to personnel preparation in special education. This paper describes instructional applications of digital media and outlines steps in producing audio and video segments. Digital audio and video are readily incorporated into instruction via live presentation in person or on television, via computer instruction through interactive multimedia modules, or via Web courses with materials provided for distributed or distance learning. Hardware and software needs are described for use of digital media in live presentations, computer instruction, and Web courses. The first step in producing audio and video media for instruction is selecting equipment that best fits the instructor's development capabilities, instructional goals, and equipment budget. Camera equipment, camera accessories, computer equipment, and production software are described with approximate costs. The next steps in producing audio and video media for instruction involve carefully planning, recording, editing, and compressing media segments to ensure that they contain high quality images and sounds and accurately represent the content. Tips and suggestions are offered for each of these steps. The final production step is using software to incorporate the media files into a particular application: live presentation, computer instruction, or Web course. Contains 38 references. (SV)

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DIGITAL AUDIO/VIDEO FOR COMPUTER- AND WEB-BASED INSTRUCTION FOR TRAINING RURAL SPECIAL EDUCATION PERSONNEL

Video presentations of teaching episodes in home, school, and community settings and audio recordings of personal views of parents and professionals can be important adjuncts to personnel preparation in practical professions such as special education. The use of media has been recommended as an effective strategy to accomplish three important instructional goals: 1) situated learning through the portrayal of the dimensions of the real world of professional practice (Todd, 1993; Willis & Meblinger, 1996); 2) anchored instruction to provide shared experiences for discussion and reflection (Brown, Collins, & Druguid, 1989; CTG-VLTC, 1993; Lave & Wenger, 199 1); and 3) exposure to a variety of diverse settings and perspectives (Barron & Goldman, 1994); McBride, Sharp, Hains, & Whitehead, 1995). Today's desktop computers allow any instructor to create original audio and video materials that can be tailored for a number of specific instructional uses (Howes & Pettengill, 1993; Richards, Chignell, & Lacy, 1990; Wagner, 1996). Nevertheless, to date most instructors have made little or no use of media in personnel preparation programs, whether at the preservice or inservice levels.

The revolution in desktop video production using consumer camcorders and personal computers has greatly simplified the preparation of audio- and video-based instructional materials. Any instructor, whether a classroom teacher at the elementary or secondary level or a faculty member working in an undergraduate or graduate preservice program or a staff development specialist designing inservice activities, is now able to shoot, edit, compress and format audio and video media for instructional use. The skills required to do this are well within the capability of most computer-literate people, requiring primarily an investment of time and energy to learn some basic techniques for digital video production.

Instructional Applications of Digital Media

Digital audio and video has many promising applications in the preparation of rural special education personnel. Audiovisual media have been used in creative ways for instruction: as material to supplement lecture and discussion as well as a primary delivery system fur courses; in preservice programs on campus and through distance education; and for inservice training and other staff development activities. Video segments are helpful for illustrating instructional and management procedures, for clarifying the context of classroom, home, and community settings, and for demonstrating teacher- students' interactions during instructional activities. Audio segments may be used to offer taped lectures, to present interviews with guests, or to share comments by experts. Digital media are readily incorporated into instruction via live presentations in person or on television, computer instruction through interactive multimedia modules, or Web courses with materials provided for distributed or distance learning.

Live Presentations. Digital audio and video are most often used for instruction in the context of live presentations made by an instructor to a group of learners. The capability of including media files is built into most presentation software, such as Microsoft Powerpoint, Gold Disks Astound, and Adobe Persuasion, which allow the user to link to audio or video files directly from a series of text screens. Such software ranges in price from $ 100 to $200. The media sound and images are played on the

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instructor's desktop or laptop computer and displayed to the group by means of a projection system and screen (in a live classroom) or via a television monitor (in a distance education program). The quality of the media will vary with the processing power of the computer and the compression scheme in which the media are prepared. Audio and video files played through a presentation program generally must be kept fairly short, usually no more than 5 to 10 minutes, unless large capacity storage drives (10 GB or more) are available, in which case files may be as long as 1-2 hours. The addition of audio and video media to a presentation program is a simple process that will readily be mastered by any instructor with basic computer skills.

Computer Instruction. Another application of digital audio and video is as components of computer instruction, generally designed as one or more self-study modules. Authoring software such as Macromedia Authorware and Director, Clari'Hypercard or Asymmtrix ToolKit may be used to create interactive multimedia learning materials (combining text, graphics, audio and video resources) that the user can access with a personal computer (Thibodeau, 1997). Such software ranges in price from $500 to $1000. The program (along with the sounds and images) is accessed from a storage device such as a compact disk or CDROM (650 MB) or an optical cartridge such as a Jaz drive (I and 2 GB) and played on each learner's desktop or laptop computer. The quality of the media will vary with the processing power of the computer and the compression scheme in which the media are prepared (Shaw, 1996). Audio and video files played through a multimedia program generally are often limited to 2 to 5 minutes in length because of storage constraints, with a CDROM holding up to one hour of video or 16 hours of audio (Florio, 1997). In creating media files, the instructor must consider the computer platforms and audiovisual player software that users are likely to have available. Apple's Quicktime audio and video files are most widely used because of their cross-platform compatibility. Basic authoring programs such as HyperCard are simple to learn, although more complex programs like Director have a steep learning curve and require a higher level of computer literacy and greater time and energy investment. However, the inclusion of media files in most authoring programs is quite easy and utilizes the same skills as those needed for adding media to a presentation program.

Web Courses. Many instructors are becoming interested in the development of Web courses, another growing instructional use of digital audio and video media. Instructors can use Web design software such as Adobe PageMill, Microsoft FrontPage and Clari'HomePage as well as Adobe Cyber Go Live and Macromedia Dreamweaver, to convert text, graphics, audio and video files to HTML code for use on the Web (McClelland, 1997). Such software ranges in price from $ 100 to $300. The completed course with all media resources is stored on a special computer known as a server which learners access by means of an Internet service provider in a laboratory or at home using a personal computer equipped with Web browser software. To view audio and video files on the Web, the user must have special media player software, which may be included as part of the browser or may be available as a plug-in feature. Because of Web bandwidth restrictions at the present time, audio is of adequate quality but video is usually of poor quality (Johnson, 1997). Video is limited to an image that plays in a window of 1/4 screen size or less at a rate of 10- 15 fps, appearing distorted and jerky, with frequent lack of synchronization between sound and picture. Both audio and video files may be made available for downloading (transferral to user's computer for later playback) or streaming (immediate playback using a special buffer) (Davis, 1999). It is helpful to select file formats that are widely available, such as Apple Quicktime and Real Network Real Audio /Video or to create self-extracting files with a program such as GEO Emblaze. Instructors will find it relatively easy to add audio and video files to Web design programs, although the use of streaming video may require some additional effort.

Selecting and Purchasing Audio/Video Production Components

The first step in producing audio and video media for instruction is determining what computer hardware and software and which camera, tape, and accessories best fit the instructor's development capabilities, instructional goals and equipment budget.

Camera Equipment. The best camcorder that is available or affordable should always be used because the more accurate the original image/sound, the better the final production will be (Rose, June 1998). The camera's lens determines the amount of the image that is captured. The larger the lens, the greater its magnification power, and the better the image. In addition, the greater the zoom capacity, the closer to desired image, and the more the control over what aspect of the image is shown. The camera head contains the electronic mechanisms (referred to as "chips") that capture the image. The larger the size of the chips, the more light is recorded, and the better the contrast and depth; 1/2" chips will produce a better image than 1/3" chips or smaller. The greater the number of the chips, the better the resolution, and the truer the color; three chips are better than two and both are better than a single chip. The recorder transfers the image and sound to a videotape cassette. The wider the tape, the greater the density of information that can be recorded, with tape varying from F (for professional cameras) to 1/2", 1/4" and 1/8" (for consumer models).Some cameras also have special features that can increase their usefulness, such as a shot stabilizer (which reduces shakiness in hand-held work), HiFi stereo audio (which permits recording of more than one channel of audio), or external microphone jacks (which allow the use of additional microphones directly on or in front of speakers). The type of the tape also affects image/sound quality. Generally, metal particle tape is superior to oxide tape, and name-brand tapes are often superior to less expensive tapes. Although high quality consumer analog video cameras (such as Hi8mm or SVHS) can be used for desktop video, the sounds and images must be converted to a digital signal as they are transferred to the computer for processing, with some loss of quality. The newer digital video cameras such as the Sony DCR-VXI000, Panasonic DVCPRO, and Canon XLI record all sounds and images directly as a digital signal, avoiding any quality loss and simplifying the transfer process, a significant advantage. Digital camcorders range in price from $1500 to $4000.

Camera Accessories. The quality of sound and images recorded with a camcorder can be greatly enhanced by the use of some affordable sound and lighting equipment (Sauer, 1996). The accuracy and quality of recorded sound varies with the type of microphone used, as well as the distance between the source of the sound and the recording device, termed the "signal-to-noise ratio". The broader the scope of the microphone's sound collection, the less faithfully it will portray a single sound. The greater the distance between the source and the device, the more extraneous noise will be recorded to produce distortion. Therefore, the rule in audio recording is to locate the microphone as close to the speaker as possible and to use a microphone designed to maximize the desired sound as well as possible and minimize other sounds (Rising, 1997). The microphone on most camcorders is generally of low quality and positioned too far away from the speaker to record sound well. So it may be desirable to take advantage of the external microphone jacks on the camcorder. A small lavalier microphone can be clipped to the speaker's lapel or shirt just below the mouth and wired directly to the camera or to a wireless unit to allow movement. A boom microphone positioned on a pole can be extended over a group of speakers and redirected toward each person's mouth as he or she speaks. An inexpensive lavalier microphone wireless system is available from Sony for around $100. Since room lighting is often dim or displayed in the wrong direction, it can also be helpful to use additional lights to highlight the focus of interest. Affordable professional lights are available from Lowell for $150 apiece; each fixture includes a telescoping stand and metal shades (known as "barn doors" that allow the light to be directed more precisely. Inexpensive halogen lights (either floor models or hanging work lights) purchased at the local

hardware store may also be used for lighting scenes. It is helpful to place at least one light to illuminate the subject's head and shoulders to separate him or her from the background to some extent. It is also important to avoid shining the light directly on the main area to prevent glare.

Computer System. The quality and capacity of the computer system to be used to process the audio and video files will determine not only the quality of the finished product, but also the ease with which it is prepared (Sauer, March 1997). Capture and editing systems are available in a wide range of prices for both Macintosh and PC platforms, but many video professionals prefer Macintosh computers because of their superior handling of graphics and video. The desktop computer's Central Processing Unit (CPU) needs to be powerful enough to handle the large file sizes needed for audio and video with relative speed. The CPU should have a minimum of 200 MHZ with at least 40 MB RAM machine memory. The system should have a color monitor that is at least 15"; a 17" monitor is preferred and even larger monitors may be desirable for more complex editing tasks. An appropriately equipped computer is likely to cost $3000 to $5000. It will be necessary to install a video capture board to allow import, processing, and export of sounds and images (McMahon, 1998). Analog video boards, such as Apple AV (available in AV-equipped Macintosh computers only), Truevision Targa, and Video Toolkit, typically range in price from $250 to $5000. The newer digital boards, including Apple "Firewire" , DPS Spark, Radius MotoDV, and Pinnacle MiroMotion, typically cost $250 to $ 1000. Appropriate cable must be purchased to connect the camcorder or other recording device to the video board to transfer the sounds and images from the tape to the computer.

Production Software. The type and variety of software needed will depend on the complexity of the video productions desired. Fairly simple video and audio segments are easily produced with basic editing software, while more elaborate productions that involve text and graphics, special effects, animation and compositing will require the use of multiple applications. Video editing software allows audio and video materials to be selected, sequenced, transformed in various ways, and compressed, all in the same program. The leading program is the cross-platform Adobe Premiere, but programs like Strata Videoshop, and Avid Cinema also can be used on the Macintosh, while FastVideo and Speed Razor are available for PC users. Editing programs typically cost anywhere from $250 to $1000, depending on their features. If additional special effects are to be added to the video, software programs that create these components must also be purchased, unless they are included in the editing program (many are). Programs such as Adobe Photoshop and Illustrator, Corel Draw and Paint, and Macromedia Freehand are used for designing text and graphics, while programs like Adobe After Effects and Boris Fx are used for animation and compositing. Each of these programs ranges in price from $200 to $1000.

Tips for Selecting Components. Instructors who are preparing to select and purchase audio and video production components are advised to learn as much as possible about their needs and available options before making the final decision. Information about computer hardware and software can be easily obtained by checking distributor catalogs, visiting company Web sites, and consulting trade magazine reviews. It is also helpful to consult with others who have used specific products, especially for information about user friendliness and system compatibility.

Recording and Editing Audio and Video Segments

The next step in producing audio and video media for instruction is carefully planning and executing the activities associated with recording and editing segments to insure that segments collected will contain high quality images and sounds and will accurately represent the content.

Planning Media Segments. The instructor will first need written permission to videotape in the desired school, home, or community settings. This is best accomplished by contacting the individual or agency and requesting a letter of permission as well as asking all persons who appear in the videotape to sign release forms that allow their image and voice to be used. Then the instructor will need to determine the best times for videotapng to be scheduled, depending on what activities and people must be included, minimizing as much as possible any interruptions or problems. Once the location, timeline and events have been decided upon, the instructor should survey (or "scout") the location to identify any problems. The instructor can look for sources of "audio noise" (continuous sounds such as machines and electrical interference as well as intermittent sounds such as announcement systems or ringing telephones) as well as "video noise" (distracting patterns such as busy backgrounds as well as random movements such as people passing by) that may lower the quality of the recorded sounds and images. Then steps may be taken to reduce or eliminate "noise", such as unplugging machines or turning off lights that hum, replacing wall hangings or blocking passageways. At this time, the instructor can also prepare the people (or "talent") who will be videotaped to discuss their role and or rehearse their performance (Cauttero & Danese, 1997). It is also helpful to provide talent with advance information, such as a list of interview questions and instructions for dress and grooming.

Recording Media Segments. Determining the focus of interest in each activity to be recorded (for example, the face during a personal interview, the hands during a demonstration, or the interaction between instructor and learner in a teaching episode, is critical to making decisions about how best to arrange the scene and equipment (Ozer, 1998). The camera should be located to get the best shots of the main action, with an appropriate background that is neither busy nor flat with minimum "noise". Positioning the camera on a tripod insures better shooting; if handheld shooting is necessary, the camcorder may be held close to the chest, using the elbows against the sides to form a natural tripod. The instructor should place the camera as close to the action as possible to minimize the need to zoom (move in and out) or pan (move side to side) because these moves create problems in compression. The microphone(s) should be placed directly on the chest clothing of any speaker(s) on the body plane directly aligned with their mouth(s); wireless microphones should be used if the speakers will need to move around (Rose, February 1998). The instructor should ask the speaker to say something and record a few words to insure that the levels are high enough and the microphone is working. If needed, one or more lighting fixtures should be placed so that the light illuminates the action, casting soft shadows to the side and behind and avoiding any hot spots in the image. The instructor may want to place transparent fabric in front of the light to lessen the glare and produce a more natural image. Once the lighting is in place, the camera's white balance setting should be adjusted as needed to guarantee color accuracy. Shooting should proceed according to the establishing sequence: a wide shot to set the scene; medium. shots as needed to draw interest to the action; and close-ups as appropriate to focus on key points (Hampe, January 1998). Shots should be composed to reflect their display on television screens and/or computer monitors, which have a 3x4 aspect ratio on a horizontal plane (sometimes called "landscape view"). Framing should create a balanced organization, locating the focus of action in the center, speaker eyes on the top third lines, titles on bottom third lines ("rule of thirds"), speaker nose just off center ("lead room") and speaker top of head just under the top of the screen ("head room"). Instructors should follow the general principle of "shoot for the edit" to insure that they return with the sounds and images that will enable them to create a high quality media production.

Editing Media Segments. All audio and video recordings should be reviewed during the transfer process so that the instructor may select the specie clips that are most likely to be used, saving disk space and simplifying the editing process. Most editing programs have a basic logging feature that allows clips to be labeled and notes to be added (Feeley, 1997). As the clips are digitized (on an analog video board) or transferred (on a digital video board), they may be stored in file folders (sometimes called "bins").

according to subject or scene. This log or "shot list" should be as accurate and informative as possible. Careful attention to labeling and storing media files saves time and trouble in editing the project at hand and also creates an archive system that can be used on future projects. Clips may be digitized or copied as they are selected or they may be selected and then processed as a whole at a later time (known as "batch digitizing"), which saves time because it can be done by the computer without supervision, except when multiple tapes are used. Once all clips have been stored, the instructor should open a project timeline in the editing program and drag the selected video and audio clips to the designated track, placing them in the desired order. Some instructors will find to helpful to develop a script (written outline) or storyboard (thumbnail sketches) prior to this step to guide them in selecting and ordering clips (Putnam, 1997). After two or more clips have been sequenced, the instructor should use the preview function to view the result and determine if any fine tuning is needed. Sometimes clips need to be trimmed, that is, modified slightly at the beginning or end to eliminate strange sounds or awkward positions. The audio and video segments need to match or be "in synch" so that what is heard occurs at the same time as what is seen and the content is consistent. Poor quality audio, such as low sound, distortions, or extraneous noises, may benefit from additional audio editing (called "sweetening") *Shaw, 1997). Once the final sequence is satisfactory, the instructor may add any special effects, such as music, text, graphics, animations or composite, layers.

Compressing Media Segments. Compression of media segments is necessary to manage audio and video files for storage and playback on a personal computer. Various compression algorithms can be used to eliminate redundant information and reduce file size (Hampe, August 1998). One minute of compact disk quality audio requires 5 MB of storage space, while one second of broadcast quality (full motion/full screen) video requires 22.5 MB of space (Azarmsa, 1998), so some degree of compression is essential. Compression may be accomplished directly through the editing program or it may be done in a separate program (Capper, 1998). The older Cinepak format produces extremely small, but low quality files, but is generally not needed with today's more powerful computers. The newest Sorenson format now available through Apple Quicktime or Terran Interactive Media Cleaner Pro offers better quality at a reasonable file size. The alternative high quality MPEG1 format produces the highest quality image at the smallest file size and is now easily produced using Heuris Power Professional encoding software. To compress and audio or video file, the instructor selects the type of video file (Apple's Quicktime for both platforms, Microsoft's AVI for PC only) with consideration for the hardware and software on which the user will play back the media files. Successful compression achieves a good balance between high quality sound/image and small file size that is appropriate to the content.

Incorporating Audio/Video Media into Computer- and Web-based Instruction

The final step in producing audio and video media for instruction is using software to incorporate the media files into a particular application such a live presentation, computer-based instruction, or course materials delivered on the Web.

Using Media in Presentations. Most instructors will want to use audio and video media in the context of a presentation program, such as the widely used Microsoft Powerpoint, which is designed to include media along with text and graphics in a series of slides (Hampe, 1997). To add media to a presentation, the instructor first creates a text screen with the desired heading and content. Then the instructor accesses the menu command to insert an audio or video clip and selects the desired file by name. It may be necessary to consult the manual for the presentation program to determine which audio and video file formats can be used. If the existing format is not compatible with the program, it may be necessary to use a file conversion program to create the need format before selecting the file to insert. Once the selection has been made, the audio or video file will automatically play as soon as the text

screen is accessed. To delay playback, the instructor can also create a new text screen that contains the audio or video file only, then add a button to the original text screen to link to the video. It is important to remember that media files used in a presentation program do not become a part of the program; rather, the program searches for and opens them from another location on the desktop. Thus, the instructor must make sure that all audio and video files that accompany a presentation have been loaded onto the computer from which the presentation will be displayed.

Using Media in Computer Instruction. Some instructors will be willing to learn a simple authoring program such as Macromedia Director to use audio and video media in the context of interactive multimedia self-studies modules administered to learners individually by computer (Roberts, 1995). To add media to a multimedia module, the instructor first programs a frame (sometimes called a "card") that contains desired text or graphic content and navigation aids for user interaction. Then the instructor accesses the menu command to import an audio or video clip and selects the desired file by name. The media file format chosen will depend on the platform and media player software likely to be available to users; it is advisable to use cross-platform formats whenever possible. Once the selection has been made, a dialog box will appear to allow adjustment of playing characteristics of the media (such as immediate versus delayed playback or continuous looping or options for interruption). Media files used in an authoring program are stored along with the program and subsequently to each user's copy (Stem & Lettieri, 1996). When the final version is ready, the multimedia program is transferred to some portable storage medium, such as an optical cartridge or a compact disk (CDROM). The program is then packaged and distributed to learners, who play the program and its media files on a personal computer.

Using Media in Web Courses. Many instructors are using a Web design program such as Adobe PageMill to incorporate audio and video files as resources for Web-based courses (Leland, 1997). To add media to a Web course, the instructor first creates a page with the desired heading and content. Next, the instructor decides whether the media will be available as a downloading file (for transfer to and later playback on the user's computer) or a streaming file (for immediate playback on the desktop). No special processing is necessary for downloading files, but additional coding will be needed for streaming files. In either case, the media file format chosen will depend on the platform and media player software likely to be available to users; it is advisable to use widely available formats whenever possible. Then the instructor accesses the menu command to locate an audio or video clip and selects the desired file by name. If the file will be downloaded, no additional steps are taken. If files will be streamed, the instructor will need to write additional HTML source code or use other encoding software to prepare them. When all Web course resources have been assembled, the instructor publishes them to a server, a computer equipped with sufficient storage space and processing speed as well as special server software that will distribute files to users on demand (Cooper, 1999).

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